

Claims

1. A method of measuring wheel alignment of an automobile carried in suspension through an automobile assembly line, a wheel installation portion yet to be fitted with a wheel being capable of being lifted and lowered while keeping an automobile body in suspension, comprising:

    a wheel installation portion lifting step of lifting the wheel installation portion to a predetermined vertical position;

    a measuring step of measuring a position of the wheel installation portion and an inclination angle of the wheel installation portion in a predetermined direction during lift in the wheel installation portion lifting step; and

    an inclination angle calculating step of calculating the inclination angle of the wheel installation portion in the predetermined direction in a finished vehicle state of the automobile from the measurement value obtained in the measurement step,

    wherein said measurement step further comprises: a deviation angle detecting step of detecting the deviation angle, in a predetermined direction, of the attitude of the automobile body supported in suspension with respect to a predetermined proper attitude of the automobile body at a measurement position; and a measurement value correcting step of correcting the measurement value of the inclination angle of the wheel installation portion in the predetermined direction based on

the deviation angle detected in the deviation angle detecting step, and

in said inclination angle calculating step, the inclination angle of the wheel installation portion in the predetermined direction in the finished vehicle state of the automobile is calculated using the inclination angle of the wheel installation portion in the predetermined direction corrected in the measurement value correcting step as said measurement value.

2. The method of measuring wheel alignment of an automobile according to Claim 1, wherein the inclination angle of said wheel installation portion in the predetermined direction is a toe angle of said wheel installation portion, and

the deviation angle detected in said deviation angle detecting step is a thrust angle of the automobile body, which indicates a horizontal deviation of the longitudinal center line of the automobile body supported in suspension from a predetermined proper longitudinal center line of the automobile body at the measurement position.

3. The method of measuring wheel alignment of an automobile according to Claim 2, wherein the detection of the thrust angle of the automobile body in said deviation angle detecting step is performed simultaneously with the measurement of the position and the toe angle of the wheel installation portion being lifted.

4. The method of measuring wheel alignment of an automobile according to Claim 2 or 3, wherein said inclination angle calculating step further comprises:

a first arithmetic step of calculating the slope of each of a plurality of lines that connect a first reference coordinate point with a plurality of measurement coordinate points, the first reference coordinate point being specified by the position of the wheel installation portion measured when the lift of the wheel installation portion is started and the toe angle of the wheel installation portion measured at the position and corrected in the measurement value correcting step, and the plurality of measurement coordinate points being specified by positions of the wheel installation portion measured at predetermined intervals until the wheel installation portion is lifted to said predetermined vertical position and toe angles of the wheel installation portion measured at the positions and corrected in said measurement value correcting step;

a second arithmetic step of calculating an estimated value of the toe angle of the wheel installation portion at a position thereof in the finished vehicle state of the automobile based on the differences between the slopes of a plurality of lines that connect a previously calculated second reference coordinate point with a plurality of preset coordinate points and the slopes of the lines that connect the first reference coordinate point with the measurement coordinate points, the

second reference coordinate point being specified by the position of the wheel installation portion designated by said first reference coordinate point and a predetermined proper toe angle associated with the position, and the plurality of preset coordinate points being specified by the positions of the wheel installation portion designated by said measurement coordinate points and predetermined proper toe angles associated with the positions; and

a third arithmetic step of determining the adjustment amount of the toe angle required to achieve a proper toe angle of the wheel installation portion at the position thereof in the finished vehicle state of the automobile based on the value obtained in the second arithmetic step.

5. The method of measuring wheel alignment of an automobile according to Claim 1, characterized in that the inclination angle of said wheel installation portion in the predetermined direction is a camber angle of said wheel installation portion, and

the deviation angle detected in said deviation angle detecting step is an attitude angle of the automobile body, which indicates a deviation, from the horizontal plane, of the lateral axis of the automobile body kept in suspension before measurement of the position and the camber angle of said wheel installation portion.

6. The method of measuring wheel alignment of an automobile according to Claim 5, wherein said inclination angle calculating step further comprises:

a first arithmetic step of calculating the slope of each of a plurality of lines that connect a first reference coordinate point with a plurality of measurement coordinate points, the first reference coordinate point being specified by the position of the wheel installation portion measured when the lift of the wheel installation portion is started and the camber angle of the wheel installation portion measured at the position and corrected in the measurement value correcting step, and the plurality of measurement coordinate points being specified by positions of the wheel installation portion measured at predetermined intervals until the wheel installation portion is lifted to said predetermined vertical position and camber angles of the wheel installation portion measured at the positions and corrected in said measurement value correcting step;

a second arithmetic step of calculating an estimated value of the camber angle of the wheel installation portion at the position thereof in the finished vehicle state of the automobile based on the differences between the slopes of a plurality of lines that connect a previously calculated second reference coordinate point with a plurality of preset coordinate points and the slopes of the lines that connect the first reference coordinate point with the measurement coordinate points, the second reference coordinate point being

specified by the position of the wheel installation portion designated by said first reference coordinate point and a predetermined proper camber angle associated with the position, and the plurality of preset coordinate points being specified by the positions of the wheel installation portion designated by said measurement coordinate points and predetermined proper camber angles associated with the positions; and

a third arithmetic step of determining the adjustment amount of the camber angle required to achieve a proper camber angle of the wheel installation portion at the position thereof in the finished vehicle state of the automobile based on the value obtained in the second arithmetic step.

7. The method of measuring wheel alignment of an automobile according to Claim 2, comprising:

a data extracting step of extracting predetermined data corresponding to the mounting state of a component constituting a suspension unit when calculating the toe angle in said inclination angle calculating step; and

a determination step of determining whether the mounting state of the component constituting the suspension unit is appropriate or not based on the data extracted in the data extracting step.

8. The method of measuring wheel alignment of an automobile according to Claim 7, wherein said inclination angle calculating step further comprises:

a first arithmetic step of calculating the slope of each of a plurality of lines that connect a first reference coordinate point with a plurality of measurement coordinate points, the first reference coordinate point being specified by the position of the wheel installation portion measured when the lift of the wheel installation portion is started and the toe angle of the wheel installation portion measured at the position and corrected in the measurement value correcting step, and the plurality of measurement coordinate points being specified by positions of the wheel installation portion measured at predetermined intervals until the wheel installation portion is lifted to said predetermined vertical position and toe angles of the wheel installation portion measured at the positions and corrected in the measurement value correcting step;

a second arithmetic step of calculating slope differences between the slopes of a plurality of lines that connect a previously calculated second reference coordinate point with a plurality of preset coordinate points and the slopes of the lines that connect the first reference coordinate point with the measurement coordinate points, the second reference coordinate point being specified by the position of the wheel installation portion designated by said first reference coordinate point and a predetermined proper toe angle associated with the position, and the plurality of preset coordinate points being specified by the positions of the wheel installation portion designated by said measurement

coordinate points and predetermined proper toe angles associated with the positions; and

a third arithmetic step of determining the slope of a line that connects at least two of a plurality of coordinate points specified by the slope differences calculated in said second arithmetic step and the positions of the wheel installation portion associated with the respective slope differences and calculating the toe angle of the wheel installation portion at the position thereof in the finished vehicle state of the automobile based on the determined slope, and

in said data extracting step, the slope calculated in said third arithmetic step is extracted as first data corresponding to the mounting state of the component constituting the suspension unit, a slope difference related to the position of the wheel installation portion in the finished vehicle state of the automobile is determined based on said first data and the slope differences calculated in said second arithmetic step, and the slope difference is extracted as second data corresponding to the mounting state of the component constituting the suspension unit.

9. The method of measuring wheel alignment of an automobile according to Claim 8, characterized in that, in the case where the component constituting said suspension unit is a double-wishbone-type suspension that has an upper arm and a lower arm,

in said determination step, it is determined based on said first data whether the vertical distance between the mounting points of the upper arm and the lower arm is appropriate or not, and it is determined based on said second data whether the distance along a wheel axle between the mounting points of the upper arm and the lower arm is appropriate or not.

10. A device for measuring wheel alignment of an automobile carried in suspension through an automobile assembly line, comprising:

automobile body supporting means that supports an automobile body in suspension while allowing a wheel installation portion yet to be fitted with a wheel to be lifted and lowered;

wheel installation portion lifting means that is disposed below the automobile body supported by the automobile body supporting means and lifts the wheel installation portion to a predetermined vertical position;

first measuring means that is provided on the wheel installation portion lifting means and measures a vertical position of the wheel installation portion;

second measuring means that is provided on said wheel installation portion lifting means and measures an inclination angle of the wheel installation portion in a predetermined direction;

deviation angle detecting means that detects a deviation angle, in a predetermined direction, of the attitude of the

automobile body supported in suspension from a predetermined proper attitude of the automobile body;

measurement control means that allows the measurement of the vertical position by said first measuring means, the measurement of the inclination angle of the wheel installation portion in the predetermined direction by said second measuring means and the detection of the deviation angle of the automobile body by said deviation angle detecting means to be performed at predetermined intervals until the wheel installation portion is lifted from the position where the lift of the wheel installation portion by said wheel installation portion lifting means is started to a predetermined vertical position; and

inclination angle calculating means that calculates the inclination angle of the wheel installation portion in the predetermined direction at the position thereof in a finished vehicle state of the automobile based on the measurement value obtained by said first measuring means, the measurement value obtained by said second measuring means and the angle detected by said deviation angle detecting means.

11. The device for measuring wheel alignment of an automobile according to Claim 10, wherein the inclination angle of said wheel installation portion in the predetermined direction is a toe angle of said wheel installation portion, and

the deviation angle detected by said deviation angle detecting means is a thrust angle of the automobile body, which

indicates a horizontal deviation of the longitudinal center line of the automobile body supported in suspension from a predetermined proper longitudinal center line of the automobile body.

12. The device for measuring wheel alignment of an automobile according to Claim 11, wherein said inclination angle calculating means comprises:

a first arithmetic means that calculates the slope of each of a plurality of lines that connect a first reference coordinate point with a plurality of measurement coordinate points, the first reference coordinate point being specified by the position of the wheel installation portion measured when the lift of the wheel installation portion is started and the toe angle of the wheel installation portion measured at the position and corrected based on the angle detected by said deviation angle detecting means, and the plurality of measurement coordinate points being specified by positions of the wheel installation portion measured at predetermined intervals until the wheel installation portion is lifted to said predetermined vertical position and toe angles of the wheel installation portion measured at the positions and corrected based on the angle detected by said deviation angle detecting means;

a second arithmetic means that calculates an estimated value of the toe angle of the wheel installation portion at the position thereof in the finished vehicle state of the

automobile based on the differences between the slopes of a plurality of lines that connect a previously calculated second reference coordinate point with a plurality of preset coordinate points and the slopes of the lines that connect the first reference coordinate point with the measurement coordinate points, the second reference coordinate point being specified by the position of the wheel installation portion designated by said first reference coordinate point and a predetermined proper toe angle associated with the position, and the plurality of preset coordinate points being specified by the positions of the wheel installation portion designated by said measurement coordinate points and predetermined proper toe angles associated with the positions; and

a third arithmetic means that determines the adjustment amount of the toe angle required to achieve a proper toe angle of the wheel installation portion at the position thereof in the finished vehicle state of the automobile based on the value obtained by the second arithmetic means.

13. The device for measuring wheel alignment of an automobile according to Claim 10, characterized in that the inclination angle of said wheel installation portion in the predetermined direction is a camber angle of said wheel installation portion, and

the deviation angle detected by said deviation angle detecting means is an attitude angle of the automobile body,

which indicates a deviation, from the horizontal plane, of the lateral axis of the automobile body kept in suspension.

14. The device for measuring wheel alignment of an automobile according to Claim 13, characterized in that said inclination angle calculating means further comprises:

a first arithmetic means that calculates the slope of each of a plurality of lines that connect a first reference coordinate point with a plurality of measurement coordinate points, the first reference coordinate point being specified by the position of the wheel installation portion measured when the lift of the wheel installation portion is started and the camber angle of the wheel installation portion measured at the position and corrected based on the angle detected by said deviation angle detecting means, and the plurality of measurement coordinate points being specified by positions of the wheel installation portion measured at predetermined intervals until the wheel installation portion is lifted to said predetermined vertical position and camber angles of the wheel installation portion measured at the positions and corrected based on the angle detected by said deviation angle detecting means;

a second arithmetic means that calculates an estimated value of the camber angle of the wheel installation portion at the position thereof in the finished vehicle state of the automobile based on the differences between the slopes of a plurality of lines that connect a previously calculated second

reference coordinate point with a plurality of preset coordinate points and the slopes of the lines that connect the first reference coordinate point with the measurement coordinate points, the second reference coordinate point being specified by the position of the wheel installation portion designated by said first reference coordinate point and a predetermined proper camber angle associated with the position, and the plurality of preset coordinate points being specified by the positions of the wheel installation portion designated by said measurement coordinate points and predetermined proper camber angles associated with the positions; and

a third arithmetic means that determines the adjustment amount of the camber angle required to achieve a proper camber angle of the wheel installation portion at the position thereof in the finished vehicle state of the automobile based on the value obtained by the second arithmetic means.